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Investigation of Martensitic Transformation in Austenitic Powder

the separated-out residue. The electrolytic residue does not contain austenite crystallites. As an electrolyte, an aqueous solution of hydrochloric acid (1%) was used.

The current density was 0.01 to 0.02 A/cm^2 with an electrolysis duration of four hours. The used specimens of the steel Kh12M (1.5% C, 12% Cr, and 0.3% Mo) were quenched from 1 150 °C and had an austenitic structure with residual carbides (see micro-photo, Figure 1a). Figure 16 shows a magnified photograph of the powder. Comparison of the two photographs shows that the thus produced powder is monocrystalline, i.e. each particle in the powder is one grain, since the dimensions of the powder particles are about equal to those of the (largest) grains in the metallographic cut. Study of the martensitic transformation of isolated crystals of austenite and of austenite in a monolithic specimen was carried out magnetically on an Akulov-type anisometer. The specimens were quenched from 1 150 °C and, following that, martensitic curves were plotted during cooling from room temperatures to the temperature of liquid nitrogen, both for the specimen and

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for powder produced from the same specimen. The temperature at which austenite begins to transform into martensite was found to be -25 °C for the solid specimen; cooling below that temperature brings about normal martensitic transformation. Cooling of austenitic powder of the same composition down to -196 °C did not bring about formation of martensite, as can be seen from Figure 2 in which the martensitic curves are graphed for both the solid specimen and the powder. This effect is not due to the possible saturation with hydrogen during electrolysis of the austenitic powder. Annealing at +200 °C of the powder as well as of the solid specimen did not bring about any change in the behaviour. The powder did not assume a tendency to become transformed and for the solid specimen the martensitic point also remained the same. Intensive deformation of the powder at room temperature (by means of a pestle in a mortar) results in the formation of about 5 to 10% martensite and the quantity of martensite does not increase during subsequent cooling down to the temperature of liquid nitrogen. The obtained results confirm the absence of

Card3/4 martensitic transformation in isolated austenite crystals, Investigation of Martensitic Transformation in Austenitic Powder SOV/126-6-5-36/43

as revealed in earlier work of one of the authors (Ref 4), although the method of obtaining isolated austenitic crystals differed in the two cases. Thus, no martensitic transformation takes place in austenitic monocrystalline powder. whilst in a solid steel specimen, austenite of the same composition will become transformed into martensite. Apparently, for obtaining martensitic transformation (type II) stresses are necessary which occur as a result of contact of differently orientated austenite crystals. This is a complete translation.
There are 2 figures and 4 Soviet references.

ASSOCIATION: Nauchno-issledovatel'skiy avtomobil'nyy i avtomotornyy institut (Automobile and Automobile Engine Scientific Research Institute)

SUBMITTED: May 15, 1957

Card 4/4

SOV/126-6-5-37/43

AUTHORS: Gulyayev, A. P., and Sanchuk, Ya. E.

TITLE: Effect of Deformation on the Austenite Crystal Lattice Constant in Steel Kh18N9T (Vliyaniye deformatsii na parametr kristallicheskoy reshetki austenita stali Kh18N9T)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 5, p 947 (USSR)

ABSTRACT: The effect of plastic deformation on the crystal lattice constant of the solid solution in austenite stainless steel Kh18N9T was studied. The steel had the following composition: 0.09% C, 18.8% Cr, 9.7% Ni, 0.79% Ti, 0.63% Mn and 0.46% Si. The steel was in the form of a wire, 1 mm in dia., and it was subjected to one of the following treatments:

a) hardening, or b) hardening with subsequent stabilization. In the former case samples were heated to 1150°C and quenched in water. In the latter case, samples were hardened by heating to 1050°C and quenching in water and were subsequently stabilized by 12-hour heating at 800°C. The former treatment produced a saturated solid solution

Card1/3 of carbides. The latter treatment produced, in the

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Effect of Deformation on the Austenite Crystal Lattice Constant in Steel Kh18N9T

stabilization stage, separation of carbides out of the solid solution. In the first case the lattice constant was 3.590 Å and in the second 3.583 Å. After thermal treatment, samples of 120 mm length were subjected to plastic deformation by extension up to 8%. Pieces of wire were cut out from the deformed samples and Debye X-ray diffraction patterns were obtained. The samples were etched in aqua regia down to 0.7 mm dia. A PRK-2 camera was used. Chromium emission from a BSV-4 X-ray tube was employed and the patterns obtained were measured using a Zeiss comparator. Fig.1 shows the lattice constant of the gamma-phase as a function of deformation (extension). The upper curve refers to the samples hardened at 1150 °C (saturated solid solutions). The lower curve represents samples which were hardened and stabilized. The lattice constant of the gamma-phase in the hardened samples decreases with increase of deformation. This is taken as an indication of decomposition of the solid solution. This decomposition

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frees carbides from the solution and is accompanied consequently by a fall of the lattice constant. Extension also produces transformation of the gamma-phase into the α-phase. The amount of the α-phase increases with extension and at 4% deformation it is present in measurable amounts. The lattice constant of the α-phase also decreases with increase of deformation. Deformation does not affect the lattice constant of the gamma-phase samples subjected to stabilising treatment. This is because the stabilised samples already contain appreciable amounts of carbides which have separated out of the solid solution. There is one figure.

ASSOCIATION: Moskovskiy vecherniy mashinostroitel'nyy institut (Moscow Evening Machine Construction Institute)

SUBMITTED: May 25, 1957

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1959 -

SOV/126-7-4-8/26

AUTHORS: Gulyayev, A.P. and Taratorina, M.V.

TITLE: The Effect of the Heating Rate on the Transformations in Steel During Tempering

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 7, Nr 4, pp 544-550 (USSR)

ABSTRACT: Electrotempering, i.e. tempering by passage of electric current, has become a practice widely adopted in industry and this prompted the authors of the present paper to study the effect of the heating rate on the transformations taking place in steels during tempering, a problem which so far has received attention of the Soviet workers only. The present investigation was carried out by means of dilatometric and hardness measurements, X-ray and metallographic analyses and anisometric determination of the quantity of the retained austenite. High-carbon steel U12 and a constructional steel St.45 were used as the experimental materials; for the sake of greater accuracy, silver steel wire was used for the preparation of the test pieces, 100 mm long and 3 mm diameter. Prior to the tempering experiments, the test pieces were quenched

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from 1100°C (steel U12) or 830°C (steel St.45). The transformations taking place at relatively low heating rates (2.7 x 10^{-2} to 3.2 x 10^{-1} °C/sec or 100 to 1200°C/hour), attained during furnace tempering were studied with the aid of an optical dilatometer; those occurring at faster rates of heating (0.7 x 10^{-2} to 9 x 10^{2} °C/sec), attained during electrotempering, were investigated in a capacitance dilatometer designed by Panov (Ref 5). Since the working length of the test pieces in the former and latter case was 50 and 75 mm respectively, the curves obtained for the shorter test pieces were re-plotted to give data relating to 75 mm length. In the case of steel St.45, identical dilatometer curves (Δl, mm versus temperature, Δ°C) were obtained at all heating rates between 100 and 1200°C/hour; a curve of this type is shown in Fig 1 (curve 1); curves 2, 3 and 4 in Fig 1 are the dilatometer curves of steel U12 heated at 1200, 300 and 400, and 100 and 200°C/hour, respectively. Fig 2 shows the dilatometer curves of steel U12 heated at (1) 900, (2) 750,

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(3) 490, (4) 320, (5) 107 and (6) 0.1°C/sec. The dilatometer curves of steel St.45 heated at (1) 680, (2) 400, (3) 70 and (4) 0.1°C/sec are plotted in Fig 3. (Curves 6 in Fig 2 and 4 in Fig 3 were obtained with the aid of the optical dilatometer). In the next series of experiments, the carbon content in the α solid solution and the proportion of retained austenite in steel U12 were determined by X-ray diffraction. The test pieces were heated to various temperatures at various rates of heating and quenched in water immediately after switching off the current. For comparison, test pieces heated to each tempering temperature at 0.5°C/sec and held at the temperature for 1.5 hours were also examined. The x-ray diffraction patterns were obtained with Fe - K radiation; from the variation of the distance between the (211) - (112) doublet, the variation of the tetragonality of martensite was calculated and the carbon content in the α solid solution was determined. The carbon content (%) of martensite in steel U12 as a function of the tempering

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temperature (°C) and the heating rate (°C/sec) is shown in Fig 4. The proportion of retained austenite (%) and microhardness (H_V) of steel U12 plotted as functions of the tempering temperature and the heating rate are shown in Fig 5 and 6 respectively. (The lowest curve in each of these three figures was plotted for specimens heated to the tempering temperature at 0.5°C/sec and held at the temperature for 1.5 hour). The proportion of the retained austenite was determined by visual comparison of the intensity of the homologous lines (Nechvolodov method); these data were made more accurate by determining the quentity of the retained austenite with the aid of an anisometer. Regarding the metallographic analysis, no difference in the microstructure due to different rates of heating was observed under the optical microscope in steels tempered below 600°C. The microstructures of steel U12 which after quenching from 1100°C was (a) heated to 600°C at 750°C/sec and (b) tempered at 600°C for 1.5 hours, are shown in Fig 7 (x500). Only with the aid of an electron microscope was it possible to show that the microstructure of the tempered steel was, in fact, affected by the heating rate even at low tempering temperatures. The microstructure of steel U12 quenched from 1100°C (as revealed by the electron microscope) is shown in Fig 8 (x1200). The electron microphotographs of the same steel, heated to 200°C at 750°C/sec and heated to 200°C at 0.5°C/sec and held at the temperature for 1.5 hours are reproduced in Fig 9a and b respectively. Fig 10 shows the electron microphotographs of steel U12 which after quenching from 1100°C was (a) heated to 300°C at 750°C/sec, (b) heated to 300°C at 150°C/sec and (v) held at 300°C for 1.5 hours having been brought to this temperature at 0.5°C/sec. The experimental results obtained by the present authors show that increasing the rate of heating results in partial suppression of the first transformation, although the temperature range at which this transformation takes place is significantly shifted only when the rate of heating exceeds about 500°C/sec. At slow rates of heating (0.1°C/sec or less)

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such as are attained during furnace tempering, the first transformation begins at approximately 80°C; this is marked on the dilatometer curve by the point at which the volume (length) of the specimen begins rapidly to decrease (comp Fig 2 and 3). Judging by the dilatometer curves, the first transformation still begins at about 80°C even when the rate of heating is raised to 490°C/sec; when, however, a heating rate of 750°C/sec is employed, the transformation begins at 330-350°C; at the rate of 900°C/sec it starts at 430-450°C. The same effect is revealed by the difference in the carbon content in the α solid solution in steel specimens heated to various temperatures at various rates of heating, although the X-ray analysis gives the beginning of the transformation at temperatures lower than those determined by the dilatometric measurements. While the temperature range of the first transformation is shifted at fast rates of heating only, the degree of decomposition of martensite is affected by the variation of the heating rate throughout the range of heating rates employed in

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the experiments. This is shown clearly by the dilatometer curves, while the X-ray data also indicate that the faster the rate of heating, the lower is the degree of decomposition of martensite. These findings were confirmed by the results of the metallographic analysis: electron microphotographs show that both the quantity of the precipitated carbides and their particle size decrease as the heating rate during tempering increases. Regarding the second transformation, i.e. decomposition of the retained austenite, it occurs at the studied rates of heating, although the positive dilatometric effect (expansion), characteristic for this transformation, is observed only at heating rates not exceeding 100°C/sec. (Compare Fig 1 and 2). Since anisometric measurements of the proportion of the retained austenite in specimens heated to various temperatures at various rates of heating showed that austenite does, in fact, decompose even at heating rates as high as 750°C/sec, it is suggested that the discrepancy between the X-ray and dilatometer data might

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be due to the fact that the retained austenite decomposes only during cooling from the tempering temperature, when comparatively fast rates of heating are employed; this problem, however, requires further study. The dilatometer curves of steel specimens heated at the rates of 750 to 900°C/sec show absence of any volume changes in the 300 to 400°C temperature range which could be taken as an indication that the transformations are completely suppressed in this temperature range; the results of the X-ray analysis, however, show that under these conditions there is a slight decrease in the degree of tetragonality and in the proportion of the retained austenite. It is therefore more likely that at fast rates of heating the transformations are completely suppressed at temperatures up to 200°C, after which both transformations take place simultaneously, the volumetric changes caused by them cancelling each other; when higher temperatures are reached, the first transformation predominates which results in contraction

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The Effect of the Heating Rate on the Transformations in Steel During Tempering

shown by the respective dilatometer curves. There are 10 figures, 1 table and 5 Soviet references.

ASSOCIATION: Tsentral'nyy nauchno-issledovatel'skiy institut tekhnologii i mashinostroyeniya (The Central Research Institute of Technology and Mechanical Engineering)

SUBMITTED: December 3, 1957

Card 9/9

GULYAYEV, A.P.; CHERNENKO, I.V.

Effect of plastic deformation at low temperatures on the heat-resistant properties of 18-8-Ti type austenitic steel. Issl.po zharopr.splav. 4:214-217 '59. (MIRA 13:5)
(Heat-resistant alloys) (Deformation(Mechanics))

18 (7)

AUTHORS: Gulyayev, A. P., Sanchuk, Ya. E. SOV/163-59-2-32/48

TITLE: Production of ε-Martensite in the Plastic Deformation of Steel (Obrazovaniye ε-martensita pri plasticheskoy deformatsii stali)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 2, pp 181-185 (USSR)

ABSTRACT: The formation of ε-martensite in the plastic deformation of steel of the type 1Kh18N9T was investigated. The sample was investigated radiographically after the thermal treatment in order to detect the phases. No hexagonal phase was found in the sample immediately after hardening at 1050-1150°. A γ- and an α-phase were detected in the steel sample after hardening at 1150°-1200°. A hexagonal ε-phase could be detected in steel samples which were hardened and then deformed at 20° in the case of a certain degree of deformation. The influence of the hardening temperature on the formation of the ε-phase in martensite is given in figure 1. The phase composition of steel after the deformation is summarized in table 2. The ε-phase is formed according to the reaction $\gamma \longrightarrow \varepsilon \longrightarrow \alpha$ in the case of a lower degree of deformation. The α-phase is formed according

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Production of ε-Martensite in the Plastic Deformation of Steel SOV/163-59-2-32/48

to the reaction $\gamma \longrightarrow \alpha$ in the case of a deformation degree of more than 18 %. The parameter of the crystal lattice of the γ-α-phases were determined and are given in table 3. The ε-phase is formed in the deformation of stainless austenite steel and has a hexagonal structure. A reduction of the nitrogen content and other elements in the solid γ-solution is favorable for the formation of ε-martensite in the deformation. The reduction of the deformation temperature is as well favorable for the production of ε-martensite. The radiographs of cobalt and those of the steel type 1Kh18N9T were taken and are given in figure 4 for comparison. There are 4 figures, 3 tables, and 5 references, 2 of which are Soviet.

ASSOCIATION: Moskovskiy vecherniy mashinostroitel'nyy institut (Moscow Evening Class Machine Building Institute)

SUBMITTED: July 8, 1958

Card 2/2

18(3) SOV/163-59-2-19/48

AUTHORS: Gulyayev, A. P., Artem'yeva, S. I.

TITLE: Simplified Methods of Determining the Heating Time of Steel Products in Salt Baths (Uproshchennyye metody opredeleniya vremeni nagreva stal'nykh izdeliy v solyanykh vannakh)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 2, pp 103 - 108 (USSR)

ABSTRACT: The thermal treatment is a temperature-time process. While the temperature values of the conversion processes are exactly known, this is not true for the time values. The heating time depends on many factors. Due to the manifoldness of the heat-treated steel products, it is impossible to set up a general relation between form and heating time. In the present paper, the heating times for simple geometric forms of steel were determined. For the total time of heating, the following equation is set up: $\tau_{total} = A + B$, A representing the time until the attainment of the temperature prescribed, and B the time necessary for the phase conversions the required. Figure 1 shows the dependence of the heat content and/ external and internal hardness of a cylinder on the time of heating. For the investigated bodies with 25 mm diameter or edge length, B= 1 minute. Figures 2,3,4, and 5 show the

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Simplified Methods of Determining the Heating Time of Steel Products in Salt Baths SOV/163-59-2-19/48

heating curves for ball, cylinder and two parallelepipeds. The formula for the total duration of heating, on the basis of the experiments, is indicated: $\tau_{min} = 0.1KK_1D + 1$ (D = diameter or edge length, K = form coefficient depending on the shape of body; the coefficients for the geometric forms indicated are given in tables 1 and 2; K_1 = length coefficient depending on the ratio $\frac{l}{D}$. The formula derived applies to values of D between 10-15 and 50 - 70 mm. There are 5 figures and 2 tables.

ASSOCIATION: Moskovskiy vecherniy mashinostroitel'nyy institut (Moscow Evening Course Institute for Machine Building)

SUBMITTED: March 5, 1958

Card 2/2

Gulyayev, A. P.

18(7) PHASE I BOOK EXPLOITATION SOV/3355

Akademiya nauk SSSR. Institut metallurgii. Nauchnyy sovet po probleme zharoprochnykh splavov

Issledovaniya po zharoprochnym splavam, t. IV (Studies on Heat-Resistant Alloys, vol. 4), Moscow, Izd-vo AN SSSR, 1959. 400 p. Errata slip inserted. 2,200 copies printed.

Ed. of Publishing House: V. A. Klimov; Tech. Ed.: A. P. Guseva; Editorial Board: I. P. Bardin, Academician; G. V. Kurdyumov, Academician; N. V. Ageyev; Corresponding Member, USSR Academy of Sciences; I. A. Oding, I. M. Pavlov, and I. F. Zudin, Candidate of Technical Sciences.

PURPOSE: This book is intended for metallurgists concerned with the structural metallurgy of alloys.

COVERAGE: This is a collection of specialized studies of various problems in the structural metallurgy of heat-resistant alloys. Some are concerned with theoretical principles, some with descriptions of new equipment and methods, others with properties of specific materials. Various phenomena occurring under specified conditions are studied and reported on. For details, see Table of Contents. The articles are accompanied by a number of references, both Soviet and non-Soviet.

Studies (Cont.) SOV/3355

Card 8/12

GuLyAyEv, A.P.

25(2,5) PHASE I BOOK EXPLOITATION SOV/2885

Tsentral'nyy nauchno-issledovatel'skiy institut tekhnologii i mashinostroyeniya

Povysheniye prochnosti elementov konstruktsiy i detaley mashin (Increasing the Strength of Constructional and Machine Elements) Moscow, Mashgiz, 1959. 210 p. (Series: Its: [Sbornik] kn. 91) 5,500 copies printed.

Ed. (Title page): I. V. Kudryavtsev, Doctor of Technical Sciences, Professor; Ed. (Inside book): A. G. Nikitin, Engineer; Tech. Ed.: V. D. El'kind; Managing Ed. for Literature on Transport Machine Building (Mashgiz): K. A. Ponomarev, Engineer.

PURPOSE: This collection of articles is intended for designers, process engineers, and scientific research workers in the machine-building industry.

COVERAGE: The collection contains papers dealing with experimental work done recently by TsNIITMASh. The experiments are concerned with the practical use of surface work hardening in industry. Industrial practices intended to increase the strength and service life of machine parts and constructional elements are discussed. Several articles are devoted to problems of increasing the fatigue strength of machine parts by work hardening. Industrial practices of NKMZ in Kramatorsk in external burnishing of large machine parts are presented. Tools and fixtures used in surface work hardening are described. No personalities are mentioned. References follow each article.

Kudryavtsev, I. V., T. V. Naumova, and L. M. Rozenman [Engineers]. Effect of Work Hardening on the Strength of Carbon Steels 129

Changes in hardness, ductility, yield, ultimate stress, impact toughness, and fatigue limit of carbon steels due to work hardening are investigated. Results are presented in tables and diagrams.

Kudryavtsev I. V., and T. V. Naumova. Effect of Large Plastic Deformations on the Strength Properties of Austenitic Steels 159

The investigation described in this article was conducted in order to establish the effect of extensive strain hardening on the fatigue resistance of heat-resistant steels. In addition to fatigue tests, short-time tensile, compression, impact, and hardness tests were taken. The tests were taken at room temperature (20°C) and at elevated temperatures (580°C). The effect of heat treatment on strain-hardened steels and the simultaneous effect of strain hardening and artificial aging were investigated.

Aleksandrov, B. I. [Candidate of Technical Sciences]. Fatigue Resistance of EI723 Pearlitic Steel at High Temperatures 174

The method of investigation and preparation of samples are described. The influence of temperature and external burnishing with rollers, the sensitivity to stress concentration, and the changes in microstructure due to cyclic

Card 8/10 [illegible]

Gulyayev, A. P. [Doctor of Technical Sciences, Professor], and N. P. Vorokhanova, [Engineer]. Microscopic Investigation of Plastic Deformation 188

This article describes an experimental investigation of plastic deformation with the use of the optical microscope. A titanium model of the microsection was then studied in an electron microscope. Plastic flow, changes in grain shape, and generation of cracks are discussed.

IV. MODERN STRENGTH-TESTING EQUIPMENT

Yatskevich, S. I. [Candidate of Technical Sciences], and E. Ye. Naumchenkov [Engineer]. Model U-200 Machine for Fatigue Testing Shafts With up to 200-Millimeter Diameters 201

This machine, designed and built by TsNIITMASh, requires only 16 kw. for fatigue testing 200-millimeter shafts. It employs the principle of resonance for loading. Other design considerations and operating techniques are discussed.

GULYAYEV, A. P.

18(0) PHASE I BOOK EXPLOITATION SOV/2316

Akademiya nauk SSSR. Institut nauchnoy i tekhnicheskoy informatsii

Metallurgiya SSSR, 1917 - 1957; [t.] II (Metallurgy in the USSR, 1917 - 1957; Vol 2) Moscow, Metallurgizdat, 1959. 813 p. Errata slip inserted. 3,000 copies printed.

Ed. (Title page): I. P. Bardin, Academician; Ed. (Inside book): G. V. Popova; Tech. Ed.: P. G. Islent'yeva.

PURPOSE: This book is intended for metallurgists.

COVERAGE: The articles in this collection present historical data on the achievements of Soviet metallurgy, both ferrous and nonferrous, during the period 1917-1957. Advances in theory and practical application are thoroughly discussed. Many of the articles describe the present status of individual branches of metallurgy and give an idea of what may be expected in the future. Advances made in other countries are also discussed. The articles are accompanied by a large number of references. For further coverage, see Table of Contents.

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Rykalin, N. N., Corresponding Member, USSR Academy of Sciences; N. O. Okerblom, Professor, Doctor of Technical Sciences; A. A. Yerokhin, Candidate of Technical Sciences; and M. Kh. Shorshorov, Candidate of Technical Sciences. (Institute of Metallurgy imeni A. A. Baykov, USSR Academy of Sciences; and Leningrad Polytechnic Institute) Progress in the Science of Welding Metals in the USSR 194

The authors discuss the studies that have been made in the USSR of the theoretical aspects of welding, beginning in the latter part of the nineteenth century. Specific topics are: investigation of the arc,

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theory of welding deformations and stresses, calculation methods used in planning the industrial production of welded structures, and the theory of strength of welded structures.

Kidin, I. N., Professor, Doctor of Technical Sciences. (Moscow Institute of Steel) Use of High Frequency Currents in Physical Metallurgy 214

The author discusses the following: types of phase transformations occurring during rapid heating; the magnetic theory of the kinetics of induction heating; interconnection between original structure, steel composition, and the kinetics of heating; structure of austenite formed during induction heating; transformation of austenite into martensite and tempering after high-frequency hardening; ways of improving the technology of induction heat treatment; regimes of induction hardening; and application of induction heating in carburizing.

Gulyayev, A. P., Professor, Doctor of Technical Sciences. (Moscow Evening Institute of Machine Design) Heat Treatment and Thermochemical Treatment of Steel 239

After giving a classification of the types of heat-treating processes, the

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SOV/129-59-1-4/17

AUTHORS: Gulyayev, A.P., Doctor of Technical Sciences, Professor, Lepnev, S.V., Engineer and Potak, Ya.M., Candidate of Technical Sciences

TITLE: High-strength Austenitic Steels (Austenitnyye stali vysokoy prochnosti)

PERIODICAL: Metallovedeniye i Termicheskaya Obrabotka Metallov, 1959, Nr 1, pp 10 - 15 (USSR)

ABSTRACT: Investigation of the stainless steels EI904 and EI925 has shown that if the martensitic point is at room temperature, even if the carbon content is 0.05 - 0.10%, it is possible to arrive at a high strength (90 - 130 kg/mm^2) combined with a high ductility and impact strength. The authors of this paper have attempted to verify on a series of high-nickel content steels the earlier expressed assumption that optimum mechanical properties are achieved if the test temperature corresponds with the temperature of the martensitic point (Author's Certificate dated March 25, 1957, Nr 110052). The experiments were carried out on two series of heats, one with a carbon content of 0.26% and nickel contents of 20.9, 23, 23.3, 24.3, 25.6 and 28%, the other with a carbon content of 0.41% and nickel contents of 16.8, 18.4, 20.9, 21, 22.8 and 23.6%.

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The contents of the usually present admixtures were 0.57 - 0.59% Mn, 0.30% Si, 0.019 - 0.020% S and 0.015 - 0.08% P. (The experimental part of this work was carried out with the participation of Ye.V. Yegorov). The specimens for tensile and impact tests were produced from forged rods which were hardened from 1 100 °C and cooled in air and, following that, were tested at room temperature. The mechanical properties of the experimental alloys as a function of the nickel content are graphed in Figure 2. The authors summarise their conclusions as follows: 1) steels of the transient class possess a particular combination of mechanical properties which are not encountered in steels of other types. These steels can have low yield points (20 - 40 kg/mm^2) combined with high ultimate strength values (100 - 200 kg/mm^2). The mechanical properties of these steels depend predominantly on the ability of austenite to change into martensite during deformation and also on the resistance to fracture of the martensite which forms during the tests. If hardening martensite is present in the initial structure, its strength also determines the mechanical properties of the steel; 2) tensile tests of nickel steels of the transient class which contain 0.26% C with an initially pure austenitic structure, revealed that such steels have a high plastic deformation (elongation up to 60%); the fracture takes place without necking, whereby the value of the relative elongation is larger than that of the relative transverse contraction. It was confirmed that for steels with unstable austenite, it is possible to obtain a combination of strength and ductility which apparently cannot be achieved for steels of other types of structure. There are 2 figures, 1 table and 4 references, 2 of which are Soviet, 1 American and 1 German.

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18(3)

AUTHORS: Gordon, I. Z., Gulyayev, A. P. SOV/163-59-1-42/50

TITLE: Influence of the Duration of Drawing Upon the Mechanical Properties of Steel (Vliyaniye prodolzhitel'nosti otpuska na mekhanicheskiye svoystva stali)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 1, pp 220-224 (USSR)

ABSTRACT: This is an investigation of the problem, whether in cases where by means of different drawing methods the same hardness is obtained, the other mechanical properties are also equal. Disks made of steel 50 and steel 40KhNMA with a diameter of 20 mm and a thickness of 6 mm were investigated. The steel 50 was water quenched at a temperature of 840°, the steel 40KhNMA was quenched in oil at 850°. Afterwards the disks were subjected to a drawing treatment at different temperatures (200-600°) and different halting times varying from 5 minutes to 24 hours. Equations (1), (2), and (3) are given. They hold for drawing temperatures of 200 to 600 degrees and for halting times from 10 minutes to 24 hours. The values for the hardness, the temperature and the duration of drawing were obtained according to these equations and the diagrams (Figs 1, 2) were plotted.

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Such drawing methods were selected which yielded hardness values of 30, 35, and 40 R_c with steel 50 and values of 30, 40, and 45 R_c with steel 40KhNMA, R_c denoting the Rockwell c hardness. The samples were treated under these conditions and their properties were determined. The investigations showed that if different drawing methods yield the same hardness, the other mechanical properties are also equal. The drawing methods for both steel types investigated can be selected according to the diagrams presented in this paper or according to equations (2) and (3). There are 2 figures, 7 tables, and 1 Soviet reference.

ASSOCIATION: Moskovskiy vecherniy mashinostroitel'nyy institut (Moscow Evening Class Institute of Machine Building)

SUBMITTED: March 5, 1958

SOV/126-8-3-31/33

AUTHORS: Gulya[redacted] A.P. and Zelenova, V.D.

TITLE: Investigation of the Pearlitic Transformation of Isolated Austenite Powder

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 3, pp 475-476 (USSR)

ABSTRACT: The method of isolated austenite powder manufacture from a quenched steel by anodic solution has been described by Zelenova (Ref 1). In this paper the results of a study of the pearlitic transformation of isolated austenite are given. This transformation was studied in powder separated by electrolytic solution from the quenched steel Kh12F1 (1.49% C, 12% Cr, 0.28% V). The isothermal transformation diagrams of austenite for the quenched steel Kh12F1 and for isolated austenite separated from this steel were compared. Isothermal decomposition curves for powder and solid specimens were plotted by means of an anisometer of the N.S.Akulov system for which purpose the austenite powder and solid specimens were heated to, and soaked in, the temperature range 300 to 700°C. The powder obtained by electrolytic solution of the steel was transferred to a quartz tube with a ground cork stopper.

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SOV/126-8-3-31/33

Investigation of the Pearlitic Transformation of Isolated Austenite Powder

In order to obtain the isothermal decomposition curve of austenite for the solid specimen, the latter was also placed in a quartz tube in order to ensure, as far as possible, identical conditions of heating to a constant temperature. The solid specimens and powders were, after soaking in the isothermal bath, also investigated by X-rays. In the investigation of the steel Kh12F1 an isothermal transformation of austenite in the solid specimen, as well as in the powder, has been observed in the pearlitic transformation range. The isothermal decomposition of austenite diagrams for the solid specimen and for the powder are shown in the figure on p 476. X-ray photographs, taken of the powder prior to isothermal soaking, show only austenite lines consisting of separate point reflections. X-ray photographs taken of the powder after isothermal treatment show continuous diffraction lines of the α-lattice. The X-ray pictures are identical for the powder and the solid specimens. The authors conclude that the essential difference between the isolated austenite and that of the solid specimen in the

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Investigation of the Pearlitic Transformation of Isolated Austenite Powder

initial condition is the fact that secondary stresses are absent in powder made by electrolytic solution of quenched steel. There are 1 figure and 2 Soviet references.

ASSOCIATION: Tsentral'nyy nauchno-issledovatel'skiy avtomobil'nyy i avtomotornyy institut (Central Motor Vehicle and Engine Scientific Research Institute)

SUBMITTED: February 10, 1959

Card 3/3

18.7500

66243
SOV/126-8-3-32/33

AUTHORS: Gulyayev, A.P. and Zelenova, V.D.

TITLE: Investigation of the Intermediate Transformation of Isolated Austenite Powder

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 3, pp 476-478 (USSR)

ABSTRACT: Gulyayev et alii (Ref 1) have shown that no martensitic transformation occurs in monocrystalline austenite powder made by electrolytic solution of quenched steel. The aim of this work was to establish the characteristics of the isolated austenite transformation in the intermediate temperature range and compare them with those of a solid specimen. The intermediate transformation of isolated austenite was studied in powder separated by electrolytic solution from quenched 144Kh3 steel (1.44% C, 3.45% Cr, 0.21% Si, 0.36% Mn). The investigation of the isothermal transformation of austenite of the quenched 144Kh3 steel and the separated electrolytic deposit was carried out with an anisometer of the N.S.Akulov system. Isothermal decomposition curves were plotted at 300 and 400°C. Specimens of the quenched steel and of the electrolytic deposit were heated in the

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66243

SOV/126-8-3-32/33

Investigation of the Intermediate Transformation of Isolated Austenite Powder

anisometer bath and held there for different periods of time after which they were quenched in water. For solid specimens of the above steel, a transformation was observed in the temperature range 300 to 400°C. The isothermal decomposition of austenite curve at 400°C is shown in the figure on p 477. An X-ray investigation of the electrolytic deposit has shown that a small increase in magnetic induction of the powder as the result of soaking at the intermediate transformation temperature is due to the formation of Fe_3O_4. X-ray photographs of the powder after isothermal soaking are analogous to those taken of the original powder, except for the oxide lines. Thus, as in the case of the martensitic transformation, there is no intermediate transformation of isolated austenite obtained by electrolytic solution, whereas in the solid specimen it takes place in the usual way. The transformation of austenite in the medium temperature range has common characteristics with the martensitic transformation. This has led to the idea that the transformation in the medium temperature range

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66243
SOV/126-8-3-32/33

Investigation of the Intermediate Transformation of Isolated Austenite Powder

passes through martensite formation. Such a point of view has been expressed by Shteinberg (Ref 3), Minkevich (Ref 4) and Kurdyumov (Ref 5). The absence of transformation in isolated austenite in the intermediate transformation temperature range confirms the hypothesis of the martensitic nature of the $\gamma \rightarrow \alpha$ change in the bainite transformation. There are 1 figure and 5 Soviet references.

ASSOCIATION: Tsentral'nyy nauchno-issledovatel'skiy avtomobil'nyy i avtomotornyy institut (Central Motor Vehicle and Engine Scientific Research Institute)

SUBMITTED: February 10, 1958

4

Card 3/3

GULYAYEV, A.P., doktor tekhn.nauk, prof.; VOROKHANOVA, M.F., inzh.

Microscopic investigation of plastic deformation. [Trudy] TSNIITMASH 91:188-200 '59. (MIRA 12:8)
(Deformation (Mechanics)) (Metallography)

PHASE I BOOK EXPLOITATION SOV/4451

Gulyayev, Aleksandr Pavlovich, Professor, Doctor of Technical Sciences

Termicheskaya obrabotka stali (Heat Treatment of Steel) 2nd ed., rev. and enl. Moscow, Mashgiz, 1960. 495 p. 12,000 copies printed.

Reviewer: A.G. Rakhshtadt, Candidate of Technical Sciences; Managing Ed. for Literature on Metalworking and Machine-Tool Making (Mashgiz): V.I. Mitin, Engineer; Ed. of Publishing House: V.V. Rzhavinskiy, Engineer; Tech. Ed.: Z.I. Chernova.

PURPOSE: This book is intended for technical personnel working in the field of physical metallurgy and in the heat treatment of metals.

COVERAGE: The author reviews the theory and general problems of steel heat treatment on the basis of his own findings. The mechanism of metal phase transformation and metal crystallization is outlined. Formation and decomposition of austenite, pearlite, bainite and martensite are discussed. The effect of quench-hardening, tempering and annealing of steels is analyzed. The microphotographs used by the author were taken from works of Ye.V. Petunina, A.I. Gardin, A.N. Alfimov, V.D. Zelenova, M.P. Zel'bet, M.V. Taratorina, and others. There are 519 references, mostly Soviet.

Card 1/7

PHASE I BOOK EXPLOITATION SOV/5116

Akademiya nauk SSSR. Institut mashinovedeniya

Instrumental'nyye rezhushchiye materialy (Cutting-Tool Materials) Moscow, Izd-vo AN SSSR, 1960. 137 p. 6,000 copies printed.

Resp. Ed.: A. I. Isayev, Doctor of Technical Sciences, Professor; Ed. of Publishing House: G. B. Gorshkov; Tech. Ed.: N. F. Yegorova.

PURPOSE: This collection of articles is intended for scientific personnel and production engineers engaged in the manufacture and use of cutting tools.

COVERAGE: The collection contains papers read at a seminar on cutting-tool materials organized and sponsored by the Komissiya po tekhnologii mashinostroyeniya (Commission on Processing in Machine Building). The seminar investigated the cutting properties of ceramic and carbide tool materials, the effect of temperature on cutting edges, the problem of wear, and the possibility of using cutting tools more efficiently. No personalities are mentioned. References accompany each article. There are 81 references: 79 Soviet, and 2 English.

Card 1/3

TABLE OF CONTENTS:

GRUZIN, P.L.; GULYAYEV, A.P.; MARTINSON, V.G.; POLIKARPOV, Yu.A.

Investigating the temperature relation of the self-diffusion ratio of iron in steel. Izv. vys. ucheb. zav.; chern. met. no.1:167-170 '60. (MIRA 13:1)

1.Moskovskiy vecherniy mashinostroitel'nyy institut i TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii.
(Iron--Isotopes) (Diffusion)

GULYAYEV, A.P.; KRAYNEVA, Z.A.

Steel tempering in a clamping device. Izv. vys. ucheb. zav.; chern. met. no.2:121-123 '60. (MIRA 15:5)

1. Moskovskiy vecherniy mashinostroitel'nyy institut.
(Steel--Heat treatment)
(Tempering--Equipment and supplies)

S/137/61/000/005/051/060
A006/A106

24566

18.1111

AUTHORS: Gulyayev, A. P.; Rustem, S. L.; Orekhov, G. N., and Alekseyeva, G. P.

TITLE: New steels for hot press forging of heat resistant alloys

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 5, 1961, 16, abstract 5I110 (V sb.: "Metallovedeniye i term. obrabotka metallov" [Tr. Sektsii metalloved. i term. obrabotki metallov. Tsentr. pravl. Nauchno-tekhn. o-va mashinostroit. prom-sti. no. 2] Moscow 1960, 179-196)

TEXT: The authors carried out comparative investigations of the properties (hardenability, roasting ability, heat resistance, maximum heat resistance, adhesion resistance, mechanical properties at room and higher temperatures, hardness in hot state) of 15 compositions 3Х2В8 (3Kh2V8) Cr-base die steel. These compositions are characterized by 1) higher C content at normal W content; 2) higher W content; 3) lower W content at higher Cr, V, and Ti or Cr and Si amount; 4) admixture of Mo, Co or Ni, 5) Mo instead of W and alloying with Mo, W and Ni. It was established that steels whose compositions are given in the table below, showed optimum properties. Grade 4Kh3V8M and 4KhV2M2F steels were

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S/137/61/000/005/051/060
A006/A106

New steels for hot press forging ... 24566

subjected to industrial tests and are recommended for the production of dies for the hot deformation of heat resistant parts.

Table:

Steel Grade	Alloying elements, %					
	C	Si	Cr	V	W	Mo
4Х6В6С (4Kh6V6S)	0.35-0.45	1.2-1.4	6-7	0.5-0.6	6-7	-
4Х3В8М (4Kh3V8M)	0.35-0.45	0.3-0.4	3.0-3.5	0.4-0.6	8-9	1.0-1.2
4Х3В2М2Ф (4Kh3V2M2F)	0.35-0.45	0.3-0.4	3.0-3.5	1.5-2.0	2.0-2.5	2.0-2.5
4Х3М6ВФ (4Kh3M6VF)	0.35-0.45	0.3-0.4	3.0-3.5	0.5-0.7	1.0-1.5	5.5-6.0

There are 14 references.

T. F.

[Abstracter's note: Complete translation]

Card 2/2

18.7500

78122
SOV/129-60-30-1/16

AUTHORS: Gulyayev, A. P. (Doctor of Technical Sciences, Professor), and Zelenova, V. D. (Candidate of Technical Sciences)

TITLE: Distribution of Carbon in Case-Hardened Layer of Alloy Steels

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, Nr 3, pp 2-7 (USSR)

ABSTRACT: This is a report concerning an investigation of steel 18KhGT containing 0.21% C, 1.07% Mn, 0.29% Si, 1.03% Cr, and 0.15% Ti. Some additional experiments were conducted with steel 1Kh13 (0.1% C; 13% Cr) and steel 1Kh17N2 (0.1% C; 17% Cr; 2% Ni). For comparison steel 20 (0.2% C) was investigated. The samples of steel 18KhGT (10 x 10 x 20 mm) were case-hardened in the solid carburizing agent at 920° C over a period of 3 and 6 hr. After case-hardening, some samples were quenched in oil with precooling (for precooling the samples were swiftly carried from case-hardening box

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Distribution of Carbon in Case-Hardened Layer of Alloy Steels

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to the box with carburizing agent, heated to 850° C, and held for 1 hr). The other samples were quenched, without precooling, either in oil or in 10% water solution of NaOH. Sharp hardening was applied to prevent the disintegration of martensite during the cooling. The samples of steel 20 were treated in the same manner. The high-chromium steels were carburized in gas atmosphere at 950° C for a period of 15 hr, then quenched from 1,100° C and given additional treatment at -70° C. The treated samples were subject to "in-layers" roentgenographic and chemical analyses. The experiments showed that there are two types of different distributions of carbon in case-hardened layer: "normal" distribution as in steel 20, Kh13 and Kh17; and "abnormal" as in steel 18KhGT (the abnormal distribution of carbon seemingly is observed in other low-alloy case-hardened steels; such a distribution was detected in steel 12KhN3A). The "normal" distribution is characterized by the maximum concentration of carbon on the surface and a gradual lowering of its content

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Distribution of Carbon in Case-Hardened Layer of Alloy Steels

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away from the surface. The "abnormal" distribution of carbon is characterized by the maximum content of carbon in the solution located not on the surface but at some distance away from it (though total carbon content in the layer shows maximum on the surface). Therefore there is a layer on the surface in which total carbon content is larger than its content in the solution. The excess carbon is found in carbides. All experiments are described and discussed. The process of case-hardening of high-chromium steels takes place at high temperature (950° C) and requires 15 hr. Under these conditions an equilibrium state, or that close to equilibrium, is reached, and a diffusion redistribution of chromium takes place. Case-hardening of 18KhGT steel takes place at lower temperature (920° C), and it requires only 6 hr. The initial state of 18KhGT steel corresponds to point C_0. At the beginning of saturation the concentration corresponds to point C_1. Then, as in the case of high-chromium steels, begins the stage

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of carbide formation (cementite). The formation and the growth of carbide particles causes the impoverishment (regarding carbon and chromium) of adjoining regions of austenite, which results in the decrease of general concentration of carbon in austenite. There are 9 figures.

Card 4/4

18.7500

SOV/129-60-5-2/15

AUTHORS: Andreyeva, A. G. (Engineer), Gulyayev, A. P. (Doctor of Technical Sciences, Professor)

TITLE: Case Hardening of Stainless Steels

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, Nr 5, pp 7-11 (USSR)

ABSTRACT: This is a report concerning an experimental investigation of steel Kh17N2 (EI268), containing 0.12% C; 16.7% Cr; 2.2% Ni. Case hardening was done by gas carburizing agent which forms during evaporation of pyrobenzol (mixture of benzene, toluene, etc) in the case hardening retort. The effect of depth of the layer on temperature and the duration of the process of case hardening is shown in Fig. 1. As demonstrated by Fig. 1, the temperatures 900° and 925° C are not sufficiently high to obtain a sufficient depth layer (1 mm). The one mm layer is a result of case hardening at 950°, 1,000°, and 1,050° C for 15, 5, and 3 hr. The study covered

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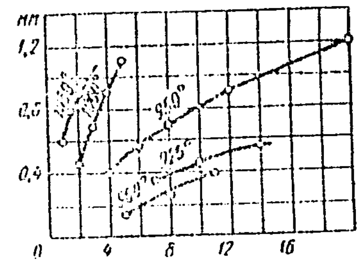
APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R000617320009-3"

Fig. 1. Effect of temperature and duration of case hardening on the depth of the layer.



the following conditions: carbon content in case hardened layer; hardness of the case hardened layer, depending on the distance from the surface (or carbon content) after quenching from various temperatures; hardness of case hardened layer of Kh17N2 steel after tempering at 160° C, depending on carbon content; thickness of hard layer (RC > 58), depending on tempering temperature for various temperatures. The authors arrived at the following conclusions. (1) For obtaining the layers of high hardness, it is

Case Hardening of Stainless Steels

SOV/129-60-3-2/16

necessary to obtain during case hardening a saturation over 2% C. The case hardening should be carried at 950° C or at 1,000° C for 15 or 5 hr to obtain layer depth of 1-1.2 mm, respectively. (2) The thickness of the layer with hardness over 58 RC depends (at a given rate of case hardening) on the conditions of subsequent heat treatment. The optimum heat treatment for obtaining maximum thickness of hard layer consists of quenching from 1,000° C, treatment by cooling at — 70° C and tempering at 160° C (or 500° C). There are 7 figures.

Card 3/3

GULYAYEV, A.P.; SPIRIDONOVA, K.S.

Mechanical properties during tool steel torsion. Izv.vys.ucheb. zav.; chern.met. no.5:142-145 '60. (MIRA 13:6)

1. Moskovskiy vecherniy mashinostroitel'nyy institut.
(Tool steel--Testing)

Gulyayev, A.I.

81875

18.7100
18.1130

S/129/60/000/08/002/009
E073/E135

AUTHORS: Gulyayev, A.P. (Doctor of Technical Sciences, Professor, and Makarov, V.M. (Engineer)

TITLE: Martensitic Transformation, Mechanical Properties and Structure of Stainless Steels of the Austenite-Martensite Class

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, No 8, pp 3-9 (+ 1 plate)

TEXT: The steels of this type which are most widely used in the U.S.S.R. are: the steel Kh17N7Yu, which corresponds to the American steel 17-7-PH, and the steel Kh15N9Yu (EI904 or SN2). The authors of this paper investigated the steel Kh15N9Yu, which has the following composition: 0.07% C; 14.9% Cr; 8.9% Ni; 1% Al. The kinetics of martensitic transformation were studied by means of the anisometric method. It was found that after quenching from 800 °C the maximum temperature of the M_{in} point equalled 80 °C, and the maximum quantity of martensite was 30% in the case of cooling to 20 °C and 70% in the case of cooling to -70 to -80 °C. If it is desired that after quenching the

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S/129/60/000/08/002/009
E073/E135

Martensitic Transformation, Mechanical Properties and Structure of Stainless Steels of the Austenite-Martensite Class

structure should remain an austenitic one and that the transformation should occur only in the case of under-cooling to sub-zero temperatures, the initial heating temperature should be about 975 °C. In this case under-cooling to -70 °C is not enough and for full martensitic transformation temperatures as low as -100 to -120 °C are required. After quenching from temperatures above 950 °C the M_{in} point is located at below zero temperatures and the structure of the steel will be an austenitic one (possibly with a certain quantity of ε-martensite). As regards the influence of the speed of cooling, the results obtained for this steel are in agreement with the influence observed in earlier work (Ref 4) on the steel Kh12F1 (1.5% C, 12% Cr, 1% V). Rapid cooling in the martensite range suppresses martensitic transformation during cooling but intensifies the transformation under isothermal conditions and during heating. The data on the results obtained from the various heat treatments are entered in Table 1. The influence of various heat treatments on the mechanical properties was also investigated and the results are entered in Table 2 and plotted in Figs 6 and 7.

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S/129/60/000/08/002/009
E073/E135

Martensitic Transformation, Mechanical Properties and Structure of Stainless Steels of the Austenite-Martensite Class

It was found that the best mechanical properties are obtained for steels containing 35-40% aged martensite and 60-65% austenite. These are obtained by quenching to produce an austenitic structure and subsequent treatment at sub-zero temperatures and ageing. Quenching from lower temperatures, of about 800 °C, will yield a similar martensite to austenite ratio but the carbides which are rejected along the grain boundaries reduce the ductility and the impact strength of the material. The structure of the steel was investigated by magnetic measurements and also by means of an electron microscope. In Fig 9 microstructure photos (X 5000) are reproduced for material which was quenched from 975 °C, and also for material quenched from 750 °C.
There are 9 figures, 2 tables and 8 references: 5 Soviet and 3 English.

Card 3/3

GULYAYEV, A.P.; ZELENOVA, V.D.

Investigating martensite transformation in isolated austenite of carbon free iron alloys. Fiz. met. i metalloved. 9 no. 4:525-529 Ap '60. (MIRA 14:5)

1. TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii i TSentral'nyy nauchno-issledovatel'skiy avtomobil'nyy i avtomotornyy institut.

(Steel—Metallography)

S/126/60/010/005/009/030
E021/E406

AUTHORS: Gulyayev, A.P. and Shigarev, A.S.

TITLE: The Formation of Martensite at High Rates of Deformation

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol.10, No.5, pp.691-697

TEXT: Two steels were tested: Х15Н9Ю (Kh15N9Yu) (0.07% carbon, 14.9% chromium, 8.9% nickel and 1% aluminium) and Х12Ф1 (Kh12F1) (1.4% carbon, 11.2% chromium and 0.7% vanadium). The following three methods of deformation were used: static compression (2 mm/min); impact (250 m/sec); and explosion (5000 m/sec). Quenching temperatures were chosen so that the steels contained approximately 8% martensite. The results of the experiments showed that as the amount of plastic deformation decreased, the amount of martensite formed also decreased. In the zones where plastic deformation was absent, no increase in the amount of martensite was observed. As the rate of deformation during the impact experiments (or the pressure developed during the explosion) increased, the quantity of martensite formed also

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S/126/60/010/005/009/030
E021/E406

The Formation of Martensite at High Rates of Deformation

increased. This must have been connected with the greater degree of transverse deformation. Martensite formed along a greater length in the samples of the Kh12F1 steel in the impact experiment because this steel had a lower plasticity, and deformed less in a transverse direction. In the explosion experiments this steel broke with a brittle fracture with no trace of plastic deformation, and no increase in martensite was observed. The method of deformation which led to the formation of the greatest quantity of martensite also gave the biggest increase in hardness. On the other hand, the method which required the greatest degree of deformation to form a given quantity of martensite also produced the biggest increase in hardness. Fig.8 shows the increase in hardness against the increase in quantity of martensite. Curves 1, 2 and 3 are for the static compression, explosion and impact experiments respectively. There are 8 figures, 3 tables and 15 references: 7 Soviet and 8 Non-Soviet.

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S/126/60/010/005/009/030
E021/E406

The Formation of Martensite at High Rates of Deformation

ASSOCIATION: Institut kachestvennoy stali TsNIIChM
(Institute of High-Grade Steel TsNIIChM)

SUBMITTED: August 31, 1959 (initially)
June 16, 1960 (after revision)

Card 3/3

GULYAYEV, A.P., doktor tekhn. nauk, prof.; MALININA, K.A., kand. tekhn. nauk; SAVERINA, S.M., inzh.; YAKOVLEVA, V.I., red.; UVOROVA, A.F., tekhn. red.

[Tool steels, properties and heat treatment; manual] Instrumental'nye stali, svoistva i termicheskaia obrabotka; spravochnik. Moskva, Gos. nauchno-tekhn. izd-vo mashinostroit. lit-ry, 1961. 205 p. (MIRA 14:8)

1. Moscow. Vsesoyuznyy nauchno-issledovatel'skiy instrumental'nyy institut.

(Tool steel)

S/137/62/000/005/094/150
A006/A101

AUTHORS: Gulyayev, A. P., Fadyushina, M. N.

TITLE: Red-heat resistance of high-speed steel

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 5, 1962, 62 - 63, abstract 5I373 (V sb. "Metodika i praktika metallogr. issled. instrum. stali", Moscow, Mashgiz, 1961, 70 - 75)

TEXT: To develop a method of testing red-heat resistance of high-speed steel, the authors studied the effect of the method and duration of heating and repeated heating upon the reduction in hardness, measured at room temperature. The investigations were made on grade P 9 (R9) steel quenched from 1,230°C and tempered 3 times at 560°C. Red-heat resistance tests are conducted as follows: specimens of a given heat are treated under conditions recommended for the given steel grade; they are then heated to 575°C with 4 hours holding time, air-cooled, and their hardness is measured. These specimens are then heated to 600°C, held for 4 hours, and the same operation is repeated and extended to 700°C. The results obtained are used for the plotting of a "hardness versus 4-hour heating-

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S/137/62/000/005/094/150
A006/A101

Red-heat resistance of high-speed steel

temperature" curve. The temperature causing a decrease in the steel hardness down to a given value, as e.g. to 58 RC, is taken as a red-heat resistance standard. Standards of red-heat resistance are given for 9 high-speed steel grades.

N. Kalinkina

[Abstracter's note: Complete translation]

1.1710 also 4016, 1413, 1454

22546
S/129/61/000/005/002/003
E111/E152

AUTHORS: Gulyayev, A.P., Professor, Doctor of Technical Sciences, and Shigarev, A.S., Engineer.

TITLE: Thermal-mechanical treatment of steel and its influence on mechanical properties

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1961, No. 5, pp. 9-12

TEXT: The work described had the object of finding the influence of changes in the degree of deformation in thermo-mechanical treatment on the mechanical properties of a steel (0.50% C, 1.55 Cr, 4.0 Ni, 0.31 Mo, 0.27 Mn, 0.25 Si, M_s = 250 °C, AC_1 730°, Ac_3 810°). 45 x 45 mm blanks were forged from 150 x 150 x 300 mm ingots and annealed at 1200 °C for 10 hours. In some experiments the properties obtained by ordinary heat treatment (oil quenching from 900 °C, tempering at 50-700 °C approx.) were studied. In the main experiments 20 x 30 x 65 mm specimens were deformed on a 100-ton press at 900 or 550 °C (actually 800-900 and 500-550 °C); some specimens were then oil quenched and others soaked at 320 °C for 2 hours (molten tin).

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S/129/61/000/005/002/003
E111/E152

Thermal-mechanical treatment of steel and its influence on mechanical properties

Impact and tensile test pieces were machined from the treated specimens and tempered at 100 °C before testing. For deformation at 900 °C followed by oil quenching the tensile strength rose continuously with rising degree of deformation (up to 90%); the toughness curve approached a limiti... value, while the yield point, elongation and reduction in a... behaved in a more complicated way due to the influence of variations in residual austenite content. In general both strength and plasticity were higher with 90% deformation than without, tensile strength 270 kg/mm^2, yield point 190 kg/mm^2, elongation 9%, decrease in cross-sectional area 22%, toughness 4 kg.m/cm^2; the corresponding values without deformation but with oil quenching being 240, 175, 6, 9, 2. With isothermal soaking after deformation at 900 °C the strength and plasticity values were not nearly so good as with the quenching; variations in residual-austenite content were similar, increasing at small deformations and decreasing with large. Deformation (up to 35%) at 550 °C followed by oil quenching showed that yield point and toughness vary with
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22546
S/129/61/000/005/002/003
E111/E152

Thermal-mechanical treatment of steel and its influence on mechanical properties

deformation as in the 900 °C-experiments; plasticity falls to 15-17% deformation and then rises to the highest value at 35%; tensile strength rises steadily. With isothermal soaking (giving bainite) after deformation at 550 °C all the mechanical properties deteriorated with increasing deformation (up to 35%): the authors suggest this aspect needs further study.

There are 3 figures and 1 table.

ASSOCIATION: TsNIIChM

X

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18 8700

S/129/61/000/007/006/016
E111/E135

AUTHOR: Gul'yaev, A.P., Doctor of Technical Sciences, Professor

TITLE: Strength of steel and the problem of alloying

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1961, No. 7, pp. 23-28

TEXT: This article consists of a discussion in general terms of the problem. The author points out that the present tensile-strength values of steel (up to 300-350 kg/mm² in test pieces and 210-[illegible]) have been achieved not by creating new types of steel [illegible] combinations of alloying components, but by obtaining [illegible] structural conditions. He discusses the relative importance of resistance to plastic deformation (theoretical [illegible] σ_s and τ_t) and to breaking (tensile strength σ_T). Roughly, where real loading can lead to appreciable plastic deformation the former are more important, otherwise the latter is more important. Improvement of both should be the aim. For determining the tensile strength it is necessary that $\sigma_s \gg \sigma_T$. Tensile strength of smooth test pieces measured at liquid-hydrogen temperatures also indicates σ_T at room temperatures. However,

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Strength of steel and the problem ... 24192
S/129/61/000/007/006/016
E111/E135

impact testing on notched specimens is more convenient. The author divides steels into the following groups according to strength: up to 70 kg/mm² (no heat treatment needed); 70-140 (hardening and tempering); 140-180 (isometric [isothermal - Abstractor] hardening of certain steels); 180-220 (ordinary heat treatment of alloy steels); 220-250 (thermo-mechanical treatment) (range of usefulness of such steels under investigation); 250-300 (obtained only in wire 1-2 mm diameter for the lower, 0.1 for the higher value, which requires patenting and suitable drawing conditions); over 300 (restricted to crystals without dislocations (whiskers)). He maintains that at a given strength level all steels have the same mechanical properties regardless of the influence of their carbon and alloying-element content. On alloying he agrees with Bain that its main function is to improve hardenability, and points out that there is an optimum alloying-element content which should not be exceeded. He summarises his views on alloying of structural steels as follows. The required hardenability must first be secured by introducing just sufficient ordinary (chromium, manganese, nickel and molybdenum) and strongly acting (boron, zirconium, rare-earths) elements. The selection of the steel type is governed by

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Strength of steel and the problem... S/129/61/000/007/006/016
E111/E135

the cross-section of the part. "Hereditary" grain fineness is secured by suitable deoxidation (Al + Ti) to give a very limited residual content of elements and, possibly, by additional "micro-alloying" (V, Nb or Ti). Ductility reserve can be increased, over that obtained by thermal improvement and fine austenite grain, by introducing nickel (1-3%). Suppression of temper brittleness is obtained by alloying with 0.2-0.4% Mo.
There are 2 figures and 2 tables.

ASSOCIATION: TsNIIChM

X

GULYAYEV, A. P., doktor tekhn. nauk, prof.; UL'YANE, Ye. A., inzh.

Effect of small additions of rare-earth metals and boron on the properties of structural steel. Metalloved. i term. obr. met. no.10:50-55 O '61. (MIRA 14:10)

1. TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii.

(Steel, Structural—Metallurgy)

GULEAEV, A. P.[Gulyayev, A. P.]; SIGAREV, A. S.[Shigarev, A. S.]

Thermomechanical treatment of steel, and its influence on mechanical properties. Analele metalurgie 15 no.4:110-113 O-D '61.

(Steel—Heat treatment)

GULYAYEV, A.P., doktor tekhn.nauk, prof.; DELLE, V.A., doktor tekhn.nauk, prof.; YUR'YEV, S.F., doktor tekhn.nauk, prof.; BORZDYKA, A.M., doktor tekhn.nauk; VYAZNIKOV, N.F., kand.tekhn.nauk

"Principles of steel alloying" by [prof.] V.S.Mes'kin. Reviewed by A.P.Guliaev and others. Stal' 21 no.5:454-455 My '61. (MIRA 14:5)

(Steel alloys--Metallurgy)

GULYAYEV, A.P., doktor tekhn.nauk; LEYKIN, I.M., kand.tekhn.nauk; ROSHCHINA, A.A., inzh.; UTKIN, V.M., inzh.

Highly resistant steel for the reinforcement of prestressed reinforced concrete construction. Stal' 21 no.10:939-944 O '61. (MIRA 14:10)

1. TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii.

(Concrete reinforcement)

14000
18.9180

26387
S/032/61/027/008/010/020
B103/B206

AUTHORS: Gulyayev, A. P., and Leshchinskaya, R. P.

TITLE: Scale of fracture surfaces of high-speed steel

PERIODICAL: Zavodskaya laboratoriya, v. 27, no. 8, 1961, 991

TEXT: The authors developed a scale for evaluating the size of austenitic grains on the fracture surfaces of high-speed steel. With normal heat treatment, high-speed steel has a fine-grained structure and conchoidal fracture. In this case, the grain size is denoted by the scale divisions 9 to 11 of the ГОСТ-5639-51 (GOST-5639-51). However, under certain conditions of heat treatment or during hot plastic deformation high-speed steel is prone to abrupt enlargement of the austenitic grains. The fracture surface of such a steel has a characteristic gloss and is called "naphthalizing". The minimum grain surface for which the individual spangles can still be differentiated with the naked eye, amounts to $\sim$ 8000 - 10,000μ^2. In the case of even smaller grains, the spangles cannot be distinguished any more and the fracture surface is conchoidal. The characteristic features of the naphthalizing fracture surface are, however,

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Scale of fracture... S/032/61/027/008/010/020
B103/B206

clearly recognized under the microscope or magnifying glass. So far there exists no quantitative determination method for the grain size in high-speed steel by means of the fracture surface. For this purpose, the authors developed a 10-step method illustrated by microphotos [Abstracter's note: not reproducible], which characterizes the size of the austenitic grains from very large to normal. Each step of the scale was photographed in 3-fold and 100-fold magnification. The numbers of the scale correspond to the scale divisions in GOST-5639-51 with respect to the surface of an average grain. The grain size of each step corresponds to the equation: $n = 2^{N-1}$, N being the number of the step, n the number of grains per 6.4 cm^2, of the reproduction surface in 100-fold magnification. The authors used various heat treatment processes (e.g., repeated hardening) in order to produce grains of different size in specimens of P18 (R18) steel. The grain size was determined on the polished microsection by calculating nodal points (S. A. Saltykov, Stereometricheskaya metallografiya (Stereometric metallography), Metallurgizdat (1958)). The authors' scale differs from that in GOST-5639-51 by classifying the microstructures as well as the fracture surfaces of the steel. Moreover, in the authors'

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S/032/61/027/008/010/020
B103/B206

Scale of fracture...

scale the degree of heterogeneity of the grain size of the same step (S_{max}/S_{aver} = ratio between the face of the largest grains and that of average ones), is much higher than in the GOST scale mentioned. The ratio S_{max}/S_{aver} fluctuates with different scale divisions between 3 and 10. An evenness of the grain size is, however, not observed in real microstructures. In the case of the naphthalizing fracture surface, this becomes specially obvious. The authors' scale is therefore very well suited for determining the grain size according to the microstructure in such specimens. There are 10 figures and 1 Soviet-bloc reference. [Abstracter's note: Essentially complete translation.]

ASSOCIATION: Vsesoyuznyy nauchno-issledovatel'skiy instrumental'nyy institut (All-Union Scientific Research Institute of Instruments)

Card 3/3

34677

S/129/62/000/002/002/014
E111/E435

18.1130

AUTHORS: Gulyayev, A.P., Doctor of Technical Sciences,
Medvedev, Yu.S., Engineer

TITLE: Stainless chromium-manganese-nickel-nitrogen stainless steels with titanium, niobium and molybdenum

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, no.2, 1962, 21-28

TEXT: The properties of chromium-manganese-nickel steels with various carbon, nitrogen, manganese, nickel, titanium, niobium and molybdenum contents were studied. It was considered that the addition of these elements would reduce the susceptibility of the steel to intergranular corrosion. The range of compositions (%) of the steels studied was: 0.03 to 0.963 C; 0.10 to 0.42 N; 16.15 to 18.67 Cr; 4.06 to 6.67 Ni; 6.3 to 10.9 Mn; 0 to 2.0 Nb; three heats also contained 0.56% T and 1.92 to 3.0% Mo but no niobium. The steels were melted in 40 kg induction furnaces from pure materials, nitrogen being introduced as 1% N ferrochromium or 4.8% N manganese. Heats were poured into square ingots, being separately alloyed with the other elements. Specimens were made

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from 4 mm thick sheets prepared by rolling at a starting temperature of 1150 - 1180°C and water quenching from 1050°C. All the steels studied belong to the austenitic or austenitic ferritic class of stainless steels. The amount of delta ferrite was determined by means of metallographic and magnetic measurements; it was found only in steels with over 0.7 or 1.3% Nb (with 0.25 and 0.41% N, respectively). The effect of plastic deformation to give 5, 10, 15 and 20% residual deformation on the test steels was studied and compared with the effect on two compositions of type 1Х18Н9Т (1Kh18N9T) steels. In the latter deformation martensite was produced but not in the chromium manganese-nickel steels whatever their nitrogen, carbon, niobium and titanium contents. The influence of prolonged heating (at 450 500, 550, 600, 650, 700°C up to 4000 hours) on the structure and toughness of the steels was studied on hardened non-standard 40 x 5 x 3 mm specimens with a notch 1.5 mm deep and 0.75 mm radius of curvature. At all holding temperatures above 450°C the toughness of Cr-Mn-Ni-N steels fell, the fall being the greater the higher the temperature. The fall is due to precipitation of carbides or carbonitrides at grain boundaries. It is known that austenitic nitrogen-containing chromium-manganese-nickel steel becomes liable to intergranular corrosion after holding at 425 to 815°C, the most widely-held explanation is that this is due to precipitation of chromium carbides and nitrides. There is little published information on the effect of niobium content while that on the effect of niobium is contradictory. The authors have studied the effect of carbon, nitrogen, nickel, manganese, niobium titanium and molybdenum, and also of stabilizing annealing on the liability of the Cr-Mn-Ni-N steels to intergranular corrosion at 450 to 750°C and holding times up to 1000 - 4000 hours. The standard АМ ГОСТ 6032-58 (AM GOST 6032-58) method was used. Boiling time was 48 hours, intergranular corrosion being determined from the appearance of cracks on bending the specimens. It was found that the steels (which are of the Х17Н4АГ8 (Kh17N4AG8) type) become liable to intergranular corrosion when heated to 450 - 800°C and are thus unsuitable for service in this range. All austenite-forming elements (carbon, nitrogen nickel and manganese) increase this tendency. Niobium and titanium increase resistance to intercrystalline corrosion, but stabilization of the steels of the type tested by adding these elements is not sufficiently effective since, to prevent formation of delta ferrite, the addition of those elements must be accompanied by an increase in the content of the austenite-forming elements (which have the opposite effect). Alloying with molybdenum, which raises the temperature range in which intergranular corrosion develops, is a promising approach for the test steels, which can then be used up to 550 - 600°C. There are 5 figures and 1 table.

ASSOCIATION: TsNIIChM, Giproneftemash

APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R000617320009-3"

GULYAYEV, A.P.

From the author [of the article under discussion]. Metalloved. i term. obr. met. no.5:29-30 My '62. (MIRA 15:5)
(Steel alloys--Testing)

GULYAYEV, A.P., doktor tekhn.nauk, prof.; KOZLOVA, G.V., inzh.; MOLCHANOVA, V.P., kand.tekhn.nauk; SMIRNOVA, T.G., inzh.

Properties of electroplated coatings on molybdenum. Metallloved. i term. obr. met. no.7:10-13 Jl '62. (MIRA 15:6)

1. TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii.

(Molybdenum)
(Electroplating)

41631

S/148/62/000/009/006/007
E021/E483

18 1152

AUTHORS: Gulyayev, A.P., Gorelik, S.S., Sen'kina, M.S.

TITLE: Structural changes during cold-working and recrystallization of molybdenum

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no.9, 1962, 160-164

TEXT: The structural changes during deformation and subsequent annealing of cast molybdenum were studied in relation to the hardening and softening processes. Bars of commercially pure molybdenum were forged at 1600°C and annealed at 1200°C for 2 hours. Samples 13 mm thick were then cut from the bars, rolled at 500°C to 30 and 80% reduction and then annealed at temperatures of up to 1500°C. The changes in the structure were followed by X-ray diffraction. The microstresses and size of the regions of coherent scattering were determined. The beginning of recrystallization was determined by the usual X-ray method. Metallographic examination and hardness measurements were also carried out. After 80% reduction, hardness of Mo increased by a factor of 1.6; this increase in hardness was considerably less

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Structural changes ... S/148/62/000/009/006/007
E021/E483

in the case of plastically deformed iron. The size of the regions of coherent scattering in molybdenum was also considerably greater in work-hardened iron. The block dimensions in Mo deformed to 80% reduction were in the region of 1100 Å. The microstresses in molybdenum and iron were approximately the same. The smaller degree of work-hardening of molybdenum as compared with other metals (iron) was thus associated with the less intense breaking-up of the coherent regions. Compared with massive Mo specimens, deformed by rolling, Mo filings were characterized by smaller block dimensions and lower microstresses. The temperatures of the beginning and the end of recrystallization after 30% reduction were, respectively, 1100 and 1500°C; the corresponding values for material given 80% reduction being 950 and 1100°C. There was no change in texture when the sample deformed to 80% reduction was heated up to 1000°C. There are 3 figures.

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S/148/62/000/009/006/007
E021/E483

Structural changes ...

ASSOCIATIONS: Moskovskiy vecherniy mashinostroitel'nyy institut
(Moscow Evening Machinery Institute)
Moskovskiy institut stali i splavov
(Moscow Steel and Alloys Institute)

SUBMITTED: November 2, 1961

Card 3/3

GULYAYEV, A.P., doktor tekhn.nauk, prof.

Effect of chromium and nickel on the ductility of steel. (MIRA 16:1)
Metalloved. i term. obr. met. no.12:2-6 D '62.

1. TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii.

(Steel--Metallurgy)

GULYAYEV, A.P.

Investigation of high-speed steel with 30 $^{o}/_{o}$ Co. Sbor.trud. TSNIICHM no.27:5-9 '62. (MIRA 15:8)
(Tool steel--Testing)

S/776/62/000/027/001/004

AUTHORS: Gulyayev, A. P., Meshcherinova, O. N., Trifonova, T. N.

TITLE: The influence of Boron on the properties of alloyed structural steels.

SOURCE: Moscow. Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii. Sbornik trudov. no. 27. Moscow, 1962. Spetsial'nyye stali i splavy. pp. 29-46.

TEXT: The paper reports the results of laboratory tests at the Central Scientific Research Institute of Ferrous Metallurgy in an attempt to employ B additions to compensate for the reduction in hardenability that is encountered in Ni-starved structural steels; the tests were made to help alleviate the difficulties engendered in the USSR by a prevailing Ni shortage. The test series described comprises 5 groups of differently alloyed steels: (1) Cr steels with an addition of B, XP (KhR) with 1% Cr + 0.002% B; (2) Cr-Ni steels, XH (KhN), with 1% Cr, 1% Ni (the latter value dependent on the content of the naturally alloyed Khalilovo pig irons); (3) Cr-Ni steels with a B addition, XHP (KhNR), with 1% Cr, 1% Ni + 0.002% B; (4) Cr-Mn steels with B, XΓP (KhGR), with 1% Mn; 1% Cr + 0.002% B; and (5) Cr-Ni-W steels with B, XHBP (KhNVR), with 1% Cr, 1% Ni, 1% W + 0.002% B. The exact compositions of the tested steels are tabulated. The paper describes: (1) The

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smelting technique; (2) the test methodology, which comprises an investigation of the growth tendency of the grain, the hardenability of the steel, the mechanical properties, the "toughness margin" or sensitivity to stress concentration, and the temper-brittleness tendency; (3) the oxidation method employed for the determination of the austenite-grain size (test results shown in full-page table); (4) the determination of the hardenability by means of the facial-hardening method; (5) tests for mechanical properties comprising tensile and impact tests and H_{R_C} tests; (6) tests for the "toughness margin," which were achieved by impact tests at various temperatures between +20 and $-100^{\circ}C$, in which the impact work and the appearance of the fracture were used as criteria (results shown in full-page tables); (7) tests for the temper-brittleness sensitivity, in which a comparison of the impact toughness and the appearance of the fracture was made between nonembrittled specimens, which had been quenched in oil and tempered for 2.5 hrs at $650^{\circ}C$ and then oil-cooled, and embrittled specimens, quenched in oil, tempered for 2.5 hrs at 650°, and further tempered in the embrittlement zone at 530° for 16 hrs; these tests ranged from +20 to $-100^{\circ}C$ (test results summarized in 2 full pages of figures). Conclusions: (1) Addition of B increases the hardenability of all of the alloyed steels tested appreciably; an addition of 0.002% B in the presence of 1% Cr increases the hardenability of the steel more intensely than the addition of 1% Ni. (2) All steels tested were naturally fine-grain upon deoxidation by the given method.

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Grain growth started in the 950-1,000°C range, in which the effect of the B consisted in a reduction of the grain-growth temperature by 50°. (3) When tempered to an identical hardness, all steels (at 20°C) exhibited approximately identical mechanical properties, regardless of their alloying-element contents. Steels with a smaller C content had greater plasticity and toughness following treatment for identical strength. (4) B increases the embrittlement-transition temperature of a steel; this effect is more pronounced when the composition of a steel is more complex. The greatest toughness margin is exhibited by the XH (KhN), B-free, steel and the low-alloyed XP (KhR). (5) All steels exhibit a tendency toward temper-brittleness, including those containing W. There are 12 figures, 6 tables, and 3 references (1 Russian-language Soviet and 2 English-language U.S.: Brown, Iron Age, VII, v.168, 1951, and Irwine, I. J., et al., Iron and Steel, no.7, 1957, 30).

GULYAYEV, A.P.; GORELIK, S.S.; SEN'KINA, M.S.

Structural changes during peening and the recrystallization of molybdenum. Izv. vys. ucheb. zav.; chern. met. 5 no.9:160-164 '62. (MIRA 15:10)

1. Moskovskiy vercherniy mashinostroitel'nyy institut i Moskovskiy institut stali i splavov.
(Molybdenum--Cold working) (Crystallization)

S/126/62/013/002/007/019
E039/E135

18.1120

AUTHORS: Gulyayev, A.P., and Leshchinskaya, R.P.

TITLE: The influence of rate of heating on grain size in austenitic high speed steel

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.2, 1962, 233-240

TEXT: High speed steel Р18 (R18) after normal heat treatment possesses small grains, but in some cases the so-called naphthalene cracking occurs. This is likely when the steel has been repeatedly hardened without intermediate annealing, and in such cases the growth of large grains of austenite is observed. This leads to a deterioration of its mechanical properties. Such samples cannot usually be improved by subsequent heat treatment. Existing theory cannot explain all the many phenomena connected with the formation of naphthalene cracking. In the present work the dependence of grain size on the rate of heating in the austenite temperature range, and also that corresponding to the $\alpha \rightarrow \gamma$ phase change is investigated for the austenitic

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high speed steel R18. The following conclusions are drawn. 1) The size of austenite grains formed by heating steel R18 up to 1280 °C depends on the speed of heating in the above temperature ranges. 2) The dependence of grain size on the rate of repeated heating has the form of a curve with a maximum corresponding to rates of the order of 50-500 °C/min. At this rate repeated heating always leads to the formation of naphthalene cracking and large grains in the microstructure. With very small (0.7 °C/min) and very large (4500 °C/min) rates of heating the grains remain small even after long soaking. Consequently repeated heating of the steel R18 up to 1280 °C without intermediate annealing leads to the formation of naphthalene cracking only at definite rates of heating. 3) By heating at a definite rate (500 °C/min) it is possible to form naphthalene cracks and coarse grains in annealed steel. 4) The structure of steel having naphthalene cracks initially is not improved by subsequent heating at any rate of heating in the range 0.7-4500 °C/min. 5) The dimensions of samples undergoing repeated heating do not influence the grain size.

The influence of rate of heating... S/126/62/013/002/007/019
E039/E135

There are 8 figures and 2 tables.

ASSOCIATION: Vsesoyuznyy nauchno-issledovatel'skiy instrumental'nyy institut (All-Union Scientific Research Institute of Instruments)

SUBMITTED: May 10, 1961

Card 3/3

ACCESSION NR AM4032514 BOOK EXPLOITATION S/

Gulyayev, Aleksandr Pavlovich

Metal science (Metallovedeniye), 4th ed. rev., Moscow, Oborongiz, 1963, 464p. 65,000 copies printed.

TOPIC TAGS: alloy theory, carbon steel, alloyed steel, nonferrous alloy, heat treatment, metal structure, heat resistant alloy, precision alloy, iron

PURPOSE AND COVERAGE: This book is a fundamental text for the course in metal science read in machine building, metallurgical, and polytechnic higher educational institutions. The book presents the basic theory of alloys, examines the properties and structure of carbon and alloyed steels, irons, heat-resistant, precision, and other alloys including nonferrous alloys and the theory and practice of heat treating metals. This new edition contains changes resulting from the development of metal science in recent years and an appendix of handbook data on the composition and properties of alloys. The book will also be useful for engineers and technicians in industry.

TABLE OF CONTENTS [abridged]:

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ACCESSION NR AM4032514

ACCESSION NR AM4032514

SUB CODE: ML SUBMITTED: 24Aug63 NR REF SOV: 147

OTHER: 002 DATE ACQ: 09Apr64

Card 3/3

GULYAYEV, A.P., doktor tekhn.nauk, prof.; MEDVEDEV, Yu.S., inzh.

Structure and stability of austenite in chromium-manganese-nickel steels with nitrogen. Metalloved. i term. obr. met. no.1:35-39 Ja '63. (MIRA 16:2)

1. TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii i Gosudarstvennyy nauchno-issledovatel'skiy i proyektnyy institut neftyanogo mashinostroyeniya.
(Chromium-manganese steel--Testing)
(Phase rule and equilibrium)

AID Nr. 984-17 6 June Gulyayev, A.P.

EFFECT OF THERMOMECHANICAL TREATMENT ON FINE STRUCTURE OF STEELS AND Ti ALLOYS (USSR)

Gulyayev, A. P., and A. S. Shigarev. Metallovedeniye i termicheskaya obrabotka metallov, no. 4, Apr 1963, 9-12. S/129/63/000/004/003/014

The Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin investigated the effect of low-temperature (LTTT, ausforming) and high-temperature (HTTT) thermomechanical treatments on the mechanical properties and fine structure of Armco iron, У12 [AISI W1] and 50XH4M (0.50% C, 1.5% Cr, 4% Ni, 0.31% Mo) steel, and OT4 (1.5% Mn, 2.6% Al) and OT4-1 (1.3% Mn, 1.4% Al) Ti alloys. In both types of TTT, specimens were deformed by a single hammer blow with reductions up to 90% in HTTT and up to 35% in LTTT and quenched in brine at -5°C. In the as-quenched condition, 5XH4M steel deformed at 750 or 900°C with reductions of 75 or 90%, respectively, had a tensile strength of 275 or 270 kg/mm², yield strength of 190 or 185 kg/mm², and reduction of area of 8 or 22% (compared with 237 kg/mm², 180 kg/mm², and 4% for conventionally hardened steel). Tempering at 100°C lowers the tensile strength by about 5 kg/mm² and raises yield strength and reduction of area somewhat. Analysis of

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EFFECT OF THERMOMECHANICAL TREATMENT (Cont.)

S/129/63/000/004/003/014

x-ray diffraction patterns revealed that the width of the (110) line of martensite produced by thermomechanical treatment is considerably narrower than that of martensite obtained by conventional hardening. The difference becomes greater with higher reductions. The phenomenon is attributed to deformation-induced precipitation of carbon from austenite, which raises the temperature of martensitic transformation and reduces the amount of residual austenite. The latter effect, however, becomes apparent only at high reductions. Reductions up to 25-30% increase the amount of residual austenite. In Ti alloys HTTT (deformation at 1000°C) was found to lower the tensile strength by 5-10 kg/mm^2 (at a reduction of 80%) but to increase ductility greatly. In OT4 alloy the maximum effect (elongation, 15%; reduction of area, 40%; notch toughness, 10 mkg/cm^2) was observed with reductions of 50-60%. In OT4-1 ductility increases steadily with increasing reduction; at 80% reduction, elongation was 17%, reduction of area 47%, and notch toughness 12 $kg\text{-}m/cm^2$. In both alloys the width of the (011) line of the α-phase was found to increase with increasing reduction, while the amount of the residual β-phase reached a maximum at 60% reduction. [DV]

L 10520-63 EWP(k)/EWP(q)/EWT(m)/BDS--AFFTC/ASD--Pf-4--JD

ACCESSION NR: AP3000960 S/0135/63/000/005/0006/0009

AUTHOR: Astaf'yev, A. S. (Candidate of technical sciences); Gulyayev, A. P. (Doctor of technical sciences); Shcherbakov, O. B. (Engineer)

TITLE: Effect of alloying elements on weldability of high-strength steels

SOURCE: Svarochnoye proizvodstvo, no. 5, 1963, 6-9

TOPIC TAGS: high-strength steel, weldability, heat-affected zone, alloying element, cooling rate

ABSTRACT: The effect of C, Mn, Si, Cr, and V on the weldability of high-strength bainitic steels, primarily on mechanical properties of the heat-affected zone, has been investigated. Small heats containing C from 0.19 to 0.37%, Mn from 1.0 to 2.3%, Si from 0.49 to 2.3%, Cr from 0 to 2.4%, and V from 0.12% melted in a laboratory arc furnace were rolled into plates 5 mm thick, annealed at 1000C, and air-cooled. Plate specimens were subjected to simulated welding cycles (rapid heating to 1350C and cooling with rates varying from 0.15 to 600C/sec) in the IMET-1 machine. It was found that by limiting the contents of C to 0.24 to 0.25%, Mn and Cr to 1.5 to 1.6% each, and Si to 0.5%, a

L 10520-63
ACCESSION NR: AP3000960

satisfactory strength in the heat-affected zone (approximately 100 kg/mm^2) could be obtained even with slow cooling (0.1C/sec) from the peak temperature of the welding cycle and without excessive embrittlement even with rapid cooling. At higher contents the tensile strength of the heat-affected zone increases considerably with cooling rates over 1.0C/sec, but the ductility drops to a very low value; for example, reduction of area drops to about 5%. Si is especially harmful; an increase in Si content to 0.71% makes the heat-affected zone brittle even at low cooling rates. Orig. art. has: 10 figures and 1 table.

ASSOCIATION: TsNIIChM im. Bardina

SUBMITTED: 00 DATE ACQ: 11Jun63 ENCL: 00

SUB CODE: MA, ML NO REF SOV: 000 OTHER: 000

mcs/CA
Card 2/2